

This listing of claims will replace all prior versions, and listings, of claims in the application:

**Listing of Claims**

1. (Previously Presented) A method for managing a network providing Input/Output (I/O) paths between a plurality of host systems and storage volumes in storage systems, comprising:

providing an application service connection definition for each of the I/O paths from a host to a storage volume;

providing at least one service level guarantee definition indicating performance criteria to satisfy service requirements included in at least one service level agreement with at least one customer for network resources;

associating each service level guarantee definition with at least one application service connection definition;

gathering, by a virtualization controller mapping physical storage resources to virtual volumes in a virtualization layer, Input/Output (I/O) performance data for I/O requests transmitted through the I/O paths;

transmitting, by the virtualization controller, the gathered performance data to a service level agreement server;

monitoring, by the service level agreement server, whether the performance data for the I/O requests transmitted through the I/O paths satisfy the performance criteria indicated in the service level guarantee definition associated with the application service connection definitions for the I/O path; and

transmitting, by the service level agreement server, commands to the virtualization controller to throttle I/O transmission over at least one connection in response to determining that the performance data for at least one connection does not satisfy the performance criteria.

2. (Previously Presented) The method of claim 1, wherein each service level guarantee definition is implemented as a separate element in at least one Extended Markup Language (XML) document, the element for the service level guarantee definition includes the performance criteria defined in the service level agreement, and wherein the application service

connection definition for each of the I/O paths is implemented as an element the at least one XML document, wherein attributes of the application service connection definition element provide information on the I/O path.

3. (Original) The method of claim 1, wherein multiple service level guarantee definitions indicating different performance criteria are associated with different sets of application service connection definitions.

4. (Previously Presented) The method of claim 3, wherein the application service definition for the I/O paths may be associated with the multiple service level guarantee definitions, wherein the monitoring comprises determining whether the I/O requests transmitted through the I/O paths satisfy the performance criteria of all associated service level guarantee definitions.

5. (Previously Presented) The method of claim 1, further comprising:  
providing an application service group identifying a plurality of application service connection definitions, wherein associating the at least one service level guarantee definition with the application service connection definitions comprises associating the at least one service level guarantee definition with the at least one application service group, wherein the application service connection definitions identified in the application service group are associated with the service level guarantee definition with which their application service group is associated.

6. (Previously Presented) The method of claim 5, further comprising:  
providing a service level commitment record associating one service level agreement definition with the at least one application service group.

7. (Previously Presented) The method of claim 5, wherein at least one Extended Markup Language (XML) document includes one element for each of the at least one application service group, and wherein the element for each of the at least one application service group includes one sub-element for each application service connection definition included in that

application service group, wherein each application service connection definition subelement includes attributes providing information on the application service connection definition.

8. (Previously Presented) The method of claim 1, wherein monitoring whether the I/O requests transmitted through the I/O path satisfy performance criteria indicated in the service level guarantee definition comprises:

- gathering performance information concerning I/O requests for the I/O paths;
- selecting one of the at least one service level guarantee definition; and
- for each of the I/O paths identified by the application service connection definition associated with the selected service level guarantee definition, comparing the gathered performance information for the I/O path with the performance criteria indicated in the selected service level guarantee definition.

9. (Original) The method of claim 8, further comprising:  
adjusting operations among the I/O paths represented by the application service connection definitions associated with the selected service level guarantee definition if the gathered performance information for the I/O paths does not satisfy the performance criteria.

10. (Previously Presented) The method of claim 9, wherein adjusting the operations comprises:

- determining the I/O paths that are over performing and under performing with respect to the performance criteria; and
- throttling the transmission of the I/O requests through the determined I/O paths that are over performing.

11. (Previously Presented) The method of claim 10, wherein throttling the transmissions comprises delaying the processing of the I/O requests transmitted through the over performing I/O paths.

12. (Previously Presented) The method of claim 8, wherein the gathering of the performance information for the I/O paths comprises determining an I/O response time and I/O

demand at the I/O paths and comparing the determined I/O response time and the I/O demand with the performance criteria for the I/O response time and the I/O demand in the selected service level guarantee definition.

13. (Previously Presented) The method of claim 12, wherein the I/O demand comprises I/O operations per second per unit of contracted storage capacity and I/O throughput per contracted storage capacity.

14. (Previously Presented) The method of claim 13, wherein one of the I/O paths is under performing if a percentage of I/O response times measured for the I/O path is less than a percentage guarantee indicated in the selected service level guarantee definition.

15. (Previously Presented) The method of claim 13, wherein one of the I/O paths is under performing if the I/O demand exceeds a demand criteria indicated in the service level guarantee definition and a sampling of the determined I/O response time is less than a response time criteria indicated in the service level guarantee definition.

16. (Canceled)

17. (Previously Presented) The method of claim 1, wherein the network comprises a Storage Area Network (SAN).

18. (Previously Presented) The method of claim 1, wherein the at least one application service connection definition, the at least one service level agreement, and the at least one service level guarantee definition, are provided by the service level agreement server in a web service architecture that interfaces with a client to provide real time performance information on the I/O paths to the client.

19. (Previously Presented) A system for managing a network providing Input/Output (I/O) paths between a plurality of host systems and storage volumes in storage systems, comprising:

a service level agreement server having a computer readable medium including:  
providing an application service connection definition for each of the I/O paths  
from one of the host systems to one of the storage volumes;  
providing at least one service level guarantee definition indicating performance  
criteria to satisfy service requirements included in at least one service level agreement  
with at least one customer for network resources;  
associating each service level guarantee definition with at least one application  
service connection definition; and  
a virtualization controller mapping physical storage resources to virtual volumes in a  
virtualization layer, wherein the virtualization controller performs operations, the operations  
comprising:  
gathering Input/Output (I/O) performance data for I/O requests transmitted  
through the I/O paths;  
transmitting the gathered performance data to the service level agreement server;  
wherein the service level agreement server further performs operations, the operations  
comprising:  
monitoring whether the performance data for the I/O requests transmitted through  
the I/O paths satisfy the performance criteria indicated in the service level guarantee  
definition associated with the application service connection definitions for the I/O paths;  
and  
transmitting commands to the virtualization controller to throttle I/O transmission  
over at least one of the I/O paths in response to determining that the performance data for  
at least one of the I/O paths does not satisfy the performance criteria.

20. (Previously Presented) The system of claim 19, wherein the service level  
agreement server computer readable medium further includes:  
at least one Extended Markup Language (XML) document having:  
(i) a separate element for the at least one service level guarantee definition,  
wherein the element for the service level guarantee definition includes the performance  
criteria defined in the service level agreement; and

(ii) a separate element for each application service connection definition for each, wherein attributes of the application service connection definition element provide information on the I/O path.

21. (Original) The system of claim 19, wherein multiple service level guarantee definitions indicating different performance criteria are associated with different sets of application service connection definitions.

22. (Previously Presented) The system of claim 21, wherein the application service definition for the I/O paths may be associated with the multiple service level guarantee definitions, wherein the monitoring comprises determining whether the I/O requests transmitted through the I/O paths satisfy the performance criteria of all associated service level guarantee definitions.

23. (Previously Presented) The system of claim 19, wherein the operations further comprise:

providing an application service group identifying a plurality of application service connection definitions, wherein associating the at least one service level guarantee definition with the application service connection definitions comprises associating the at least one of the service level guarantee definitions with the at least one application service group, wherein the application service connection definitions identified in the application service group are associated with the service level guarantee definitions with which their application service group is associated.

24. (Previously Presented) The system of claim 23, further comprising:  
a storage medium having at least one Extended Markup Language (XML) document that includes one element for each of the at least one application service group, and wherein the element for each of the at least one application service group includes one sub-element for each application service connection definition included in that application service group, wherein each application service connection definition subelement includes attributes providing information on the application service connection definition.

25. (Previously Presented) The system of claim 19, wherein monitoring whether the I/O requests transmitted through the I/O paths satisfy the performance criteria indicated in the service level guarantee definition comprises:

gathering performance information concerning the I/O requests for the I/O paths;  
selecting one of the at least one service level guarantee definition; and

for each of the I/O paths identified by the at least one application service connection definition associated with the selected service level guarantee definition, comparing the gathered performance information for the I/O path with the performance criteria indicated in the selected service level guarantee definition.

26. (Previously Presented) The system of claim 25, wherein the operations further comprise:

adjusting the operations among the I/O paths represented by the application service connection definitions associated with the selected service level guarantee definition if the gathered performance information for the I/O paths does not satisfy the performance criteria.

27. (Previously Presented) The system of claim 26, wherein adjusting the operations comprises:

determining the I/O paths that are over performing and under performing with respect to the performance criteria; and

throttling the transmission of the I/O requests through the determined I/O paths that are over performing.

28. (Previously Presented) The system of claim 25, wherein the gathering of the performance information for the I/O paths comprises determining an I/O response time and I/O demand at the I/O paths and comparing the determined I/O response time and the I/O demand with the performance criteria for response time and demand in the selected service level guarantee definition.

29. (Canceled)

30. (Previously Presented) The system of claim 19, wherein the service level agreement server implements a web service architecture that interfaces with a client to provide real time performance information on the I/O paths to the client.

31. (Previously Presented) An article of manufacture for managing a network providing Input/Output (I/O) paths between a plurality of host systems and storage volumes in storage systems, wherein the article of manufacture causes operations to be performed, the operations comprising:

- providing an application service connection definition for each of the I/O paths;

- providing at least one service level guarantee definition indicating performance criteria to satisfy service requirements included in at least one service level agreement with at least one customer for network resources;

- associating each service level guarantee definition with at least one application service connection definition;

- gathering, by a virtualization controller mapping physical storage resources to virtual volumes in a virtualization layer, Input/Output performance data for Input/Output requests transmitted through the I/O paths;

- transmitting, by the virtualization controller, the gathered performance data to a service level agreement server;

- monitoring, by the service level agreement server, whether the performance data for the I/O requests transmitted through the I/O paths satisfy the performance criteria indicated in the service level guarantee definition associated with the application service connection definitions for the I/O paths; and

- transmitting, by the service level agreement server, commands to the virtualization controller to throttle I/O transmission over at least one of the I/O paths in response to determining that the performance data for at least one of the I/O paths does not satisfy the performance criteria.

32. (Previously Presented) The article of manufacture of claim 31, wherein each service level guarantee definition is implemented as a separate element in at least one Extended



Markup Language (XML) document, the element for the service level guarantee definition includes the performance criteria defined in the service level agreement, and wherein the application service connection definition for each of the I/O paths is implemented as an element in the at least one XML document, wherein attributes of the application service connection definition element provide information on the I/O path.

33. (Original) The article of manufacture of claim 31, wherein multiple service level guarantee definitions indicating different performance criteria are associated with different sets of application service connection definitions.

34. (Previously Presented) The article of manufacture of claim 33, wherein the application service definition for each of the I/O paths may be associated with the multiple service level guarantee definitions, wherein the monitoring comprises determining whether the I/O requests transmitted through the I/O paths satisfy the performance criteria of all associated service level guarantee definitions.

35. (Previously Presented) The article of manufacture of claim 31, wherein the operations further comprise:

providing an application service group identifying a plurality of application service connection definitions, wherein associating the at least one service level guarantee definition with the application service connection definitions comprises associating the at least one service level guarantee definitions with at least one application service group, wherein the application service connection definitions identified in the application service group are associated with the service level guarantee definition with which their application service group is associated.

36. (Previously Presented) The article of manufacture of claim 35, wherein at least one Extended Markup Language (XML) document includes one element for each of the at least one application service group, and wherein the element for each of the at least one application service group includes one sub-element for each application service connection definition

included in that application service group, wherein each application service connection definition subelement includes attributes providing information on the application service connection definition.

37. (Previously Presented) The article of manufacture of claim 36, wherein the operations further comprise:

providing a service level commitment record associating one service level agreement definition with the at least one application service group.

38. (Previously Presented) The article of manufacture of claim 31, wherein monitoring whether the I/O requests transmitted through the I/O paths satisfy the performance criteria indicated in the service level guarantee definition comprises:

gathering performance information concerning the I/O requests for the I/O paths;

selecting one of the at least one service level guarantee definition; and

for the I/O path identified by the application service connection definition associated with the selected service level guarantee definition, comparing the gathered performance information for the connection with the performance criteria indicated in the selected service level guarantee definition.

39. (Previously Presented) The article of manufacture of claim 38, wherein the operations further comprise:

adjusting the operations among the I/O paths represented by the application service connection definitions associated with the selected service level guarantee definition if the gathered performance information for the I/O paths does not satisfy the performance criteria.

40. (Previously Presented) The article of manufacture of claim 39, wherein adjusting the operations comprises:

determining the I/O paths that are over performing and under performing with respect to the performance criteria; and

throttling the transmission of the I/O requests through the determined I/O paths that are over performing.

41. (Previously Presented) The article of manufacture of claim 40, wherein throttling the transmissions comprises delaying the processing of the I/O requests transmitted through the over performing I/O paths.

42. (Previously Presented) The article of manufacture of claim 38, wherein the gathering of the performance information for the I/O paths comprises determining an I/O response time and I/O demand at the I/O paths and comparing the determined I/O response time and the I/O demand with the performance criteria for response time and demand in the selected service level guarantee definition.

43. (Previously Presented) The article of manufacture of claim 42, wherein the I/O demand comprises I/O operations per second per unit of contracted storage capacity and I/O throughput per contracted storage capacity.

44. (Original) The article of manufacture of claim 43, wherein a connection is under performing if a percentage of I/O response times measured for the connection is less than a percentage guarantee indicated in the selected service level guarantee definition.

45. (Previously Presented) The article of manufacture of claim 43, wherein one of the I/O paths is under performing if the I/O demand exceeds the demand criteria indicated in the service level guarantee definition and a sampling of the measured I/O response times is less than the response time criteria indicated in the service level guarantee definition.

46. (Previously Presented) The article of manufacture of claim 31, wherein the at least one application service connection definition, the at least one service level agreement ~~guarantees~~, the at least one service level guarantee definition, are provided by the service level agreement server in a web service architecture that interfaces with a client to provide real time performance information on the I/O paths to the client.

47. (Previously Presented) A system for managing a network providing Input/Output (I/O) paths between a plurality of host systems and storage volumes in storage systems, comprising:

means for providing an application service connection definition for each of the I/O paths;

means for providing at least one service level guarantee definition indicating performance criteria to satisfy service requirements included in at least one service level agreement with at least one customer for network resources;

means for associating each service level guarantee definition with at least one application service connection definition;

means for gathering, by a virtualization controller mapping physical storage resources to virtual volumes in a virtualization layer, Input/Output (I/O) performance data for I/O requests transmitted through the I/O paths;

means for transmitting, by the virtualization controller, the gathered performance data to a service level agreement server;

means for monitoring, by the service level agreement server, whether the performance data for the I/O requests transmitted through the I/O paths satisfy the performance criteria indicated in the service level guarantee definition associated with the application service connection definitions for the I/O paths; and

means for transmitting, by the service level agreement server, commands to the virtualization controller to throttle I/O transmission over at least one connection in response to determining that the performance data for at least one connection does not satisfy the performance criteria.

48. (Previously Presented) The system of claim 47, wherein multiple service level guarantee definitions indicating different performance criteria are associated with different sets of the application service connection definitions.

49. (Previously Presented) The system of claim 47, further comprising:  
means for providing an application service group identifying a plurality of application service connection definitions, wherein associating the service level guarantee definition with the

application service connection definitions comprises associating each service level guarantee definitions with at least one application service group, wherein the application service connection definitions identified in the application service group are associated with the service level guarantee definitions with which their application service group is associated.